The Earth Science DIGEST

25¢

NOVEMBER
1950

The Earth Science Digest

Revere, Massachusetts

Vol. V November 1950 No. 4

A magazine devoted to the geological sciences.

THE EARTH SCIENCE DIGEST is open to articles of geologic interest. Manuscripts, photographs and sketches will be returned if accompanied by ample first-class postage.

Subscriptions: U. S and possessions, Canada, Philippine Is., Latin America and Spain: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Other countries: 1 year, $3.50; 2 years, $6.00. Single copies 25 cents.

Special group subscription rates allowed to educational institutions and societies.

10 or more subscriptions, $2.00 each per year.

The Earth Science Digest is the official publication of the Earth Science Institute.

Published monthly by The Earth Science Publishing Company, 77 Victoria St., Revere, Mass. Entered as second class matter April 12, 1948 at the post office at Boston, Massachusetts, under the Act of March 3, 1879.

S. ALBERT EISENBERG,
JEROME M. EISENBERG, Publishers
GERTRUDE ROBERTS, Business Manager

Contents

Cover Photo

"The Hat", as seen from the San Juan River near Mexican Hat, Utah, is a landmark in the Four Corners region, where the state lines of Utah, Colorado, Arizona and New Mexico meet. The feature is a resistant cap of sandstone now so extensively undercut that its days (or, rather years!) seem numbered. Photo by Henry P. Zuidema, University of Michigan.

LETTERS TO THE EDITOR

Nucla, Colorado
October 24, 1950

Dear Mr. Eisenberg:

I read with absorbing interest Mr. Zuidema's article "Fossil Localities of Northwestern New Mexico" in the September issue of the **Earth Science Digest.** I hope some day to have the pleasure of "horning in" on such a venture.

May I call attention to a slight error in formation nomenclature that crept into the "Generalized Geologic Section — Northwestern New Mexico"; I refer to the "Wingate ss. (Entrada of the U. S. G.G.)" All U. S. G. S. reports that have come to the writer's attention, dealing with the Wingate and Entrada sandstones, have listed them as separate stratigraphic units; the Wingate as belonging to the Glen Canyon group of Jurassic (?) age and the Entrada as a member of the San Rafael group of unquestionable Jurassic age. To the writer, who has specialized in the stratigraphy of a region which includes northwestern New Mexico, this error may have taken on more importance than is justified. But, perhaps his concern is pardonable. Imagine a vertebrate paleontologist's reaction to a statement that Brontosaurus and Diplodocus were identical dinosaurs.

The Entrada, by the way, wedges out a short distance below the Ghost Ranch while the Wingate reaches down to the middle of the State and eastward to the boundary line (See U. S. G. S. Prof. Paper 183).

Yours sincerely,
L. ZATTERSTROM

NEW MEXICAN ANTIMONY MINERAL

WASHINGTON, Nov. 18 — **Bystromite,** a new mineral which occurs only in Mexico, was described to the Mineralogical Society of America today by Professor Charles Vitaliano of the University of Indiana.

Professor Brian Mason also of the University of Indiana collaborated with Professor Vitaliano in naming the new mineral **Bystromite.** It is a magnesium antimonate and, rather than being rare, as is the case with most newly discovered minerals, is abundant at the source locality.

Analysis and description of the new mineral grew out of a collaborative research project dealing with antimony ores from Nevada, which began some 18 months ago. Study of these ores raised geological and chemical questions which required extension of the investigation to antimony ores from other localities. This resulted in study of a suite of ore specimens from mines at El Antimonio, Sonora, Mexico, in which the new mineral was discovered.

The first step in the analysis of these ores involved spectographic analysis and X-ray photographs of the powdered ores. These gave patterns which differed from those of any known mineral, suggesting that a new compound was present, and that it contained magnesium and antimony. Search of the technical literature revealed a paper published in 1941 in an obscure Swedish scientific journal describing the artificial production of a compound of magnesium and antimony. The data listed for this substance agreed excellently with that secured from analysis of the ores from En Antimonio. Since the Swedish article was written by Dr. Anders Bystrom, the new mineral was named after him.

GEOLOGICAL RESEARCH IN FINLAND

A. LAITAKARI
Director, Geological Survey of Finland

The bedrock of Finland consists of the hard crystalline types of rock generally met with in the areas of Archean rock of the world. Granitic rocks predominate, making about 75 per cent of the area; the rest includes basic magmatic rocks and metamorphic schists. This ancient rock is not covered by sedimentary strata of Paleozoic or even younger formations, but nevertheless the surface is not bare, being overlain by a thin bed of loose sediments of the Quaternary or Pleistocene period. The bedrock thus differs markedly from the mantle rock, the difference in age being enormous. It is as great as the age of the Archean rocks, which is estimated at one to two billion years. Compare to this the Pleistocene is of insignificantly short duration.

Geological research is therefore directed into two different fields which greatly deviate from each other, firstly to investigations of the bedrock and secondly to those of loose deposits, both fields involving research into the economical aspects: the prospecting of ores and other useful minerals.

The students of the Finnish bedrock are petrologists with a chemical-physical schooling, while the research of Pleistocene deposits requires a biological-geological foundation. The prospecting geologists are petrologists who have specialized in ore investigations, but the help of Pleistocene geologists is needed in some instances of ore prospecting.

As stated above, the work of the Geological Survey comprises the mapping with special studies by the Departments for the Mapping of Rocks and Superficial Deposits, and thirdly the prospecting and investigation of ores and other useful minerals. The Geological Survey of Finland is also the State Prospecting Institute. The fourth department is the Chemical Laboratory, which makes chemical analyses, etc., for the above-mentioned departments.

Finland's political territory covers an area of 337,000 sq. km., its population being about 4 millions. Finland, the most northerly civilized country in the world, is situated between the 60th and 70th Latitudes. As the greatest part of the country is covered by stony moraine and a third part of this area is unproductive peat bog, it is understandable that the density of population is small, at present being some 13 inhabitants per sq. kilometer of dry land area. Arable land is most abundant in South and West Finland where the density of population is greatest.

The staff of the Geological Survey comprises some 30 geologists and chemists with academic degrees, and in addition about 40 other persons. The field is annually assisted by 30 to 40 students of geology.

Our extensive country comprises

too vast an area for one geologist to cover and therefore geological mapping has had to be carried out on general lines (the scale being 1:400,000).. Only at present, when 80 years have elapsed since the foundation of the Survey, can more accurate geologic mapping be started. There have been comparatively few workers and small funds, but good results have been obtained in the field of prospecting. Owing to superficial deposits, the prospecting of ores is usually difficult, but on account of the magnetic and electrical properties of ores they can be found by geophysical methods, if their occurrences can be localized to some extent. The first indication of an ore-bed may be given by boulders carried away by inland ice in the Ice Age.

THE BEDROCK*

The Finnish bedrock represents a deeply eroded section of the Earth's crust, where the granitic roots of two ancient mountain chains are visible. South western Finland belongs to the early-Archean, so-called Svecofennidic mountain chain and East and North Finland to the late-Archean, so-called Karelidic one. The crystalline schists of both mountain chains are of volcanic and sedimentary rock types formed at the Earth's surface, which in the process of folding have penetrated deep into the Earth's crust and there have been intruded by granitic magmas. This is the origin of the composite rock types, the so-called migmatites so characteristic of the Finnish bedrock.

The crystalline schists, however, have preserved structural features, as relics by which it is possible to explain the conditions

*by Dr. A. Simonen, Chief of the Department.

Fig. 1. VEINED GNEISS. YLOJARVI

that existed at the surface of the Earth. The schists of the bedrock have originally been formed under similar conditions to the present formations, and the actualistic theory "the preset is a key to the past" can be applied to their study. The carbon-bearing schists also preserve evidence of organic life.

The Archean mountain chains were already levelled in the Pre-Cambrian period. Some kinds of magmatic rocks and sandstones in depressions are younger than the Archean mountain chains, but even they originated in the Pre-Cambrian period. The bedrock of Finland possesses no Paleozoic, Mesozoic or Cenozoic formations throwing light on the development of organic life. Only a thin sedimentary mantle resulting from the melting of Quaternary inland ice covers the ancient bedrock, which the ice eroded, but left fresh and unweathered.

The study of the Archean bedrock has especially promoted the elucidation of the problems concerning the origin of metamorphic schists and granitic rocks. In addition to the mapping, special investigations are being carried on in the areas giving a clearer view of the bedrock as a whole. Research of the present day strives to explain the structure of the ancient mountain chains and to throw light on the circumstances

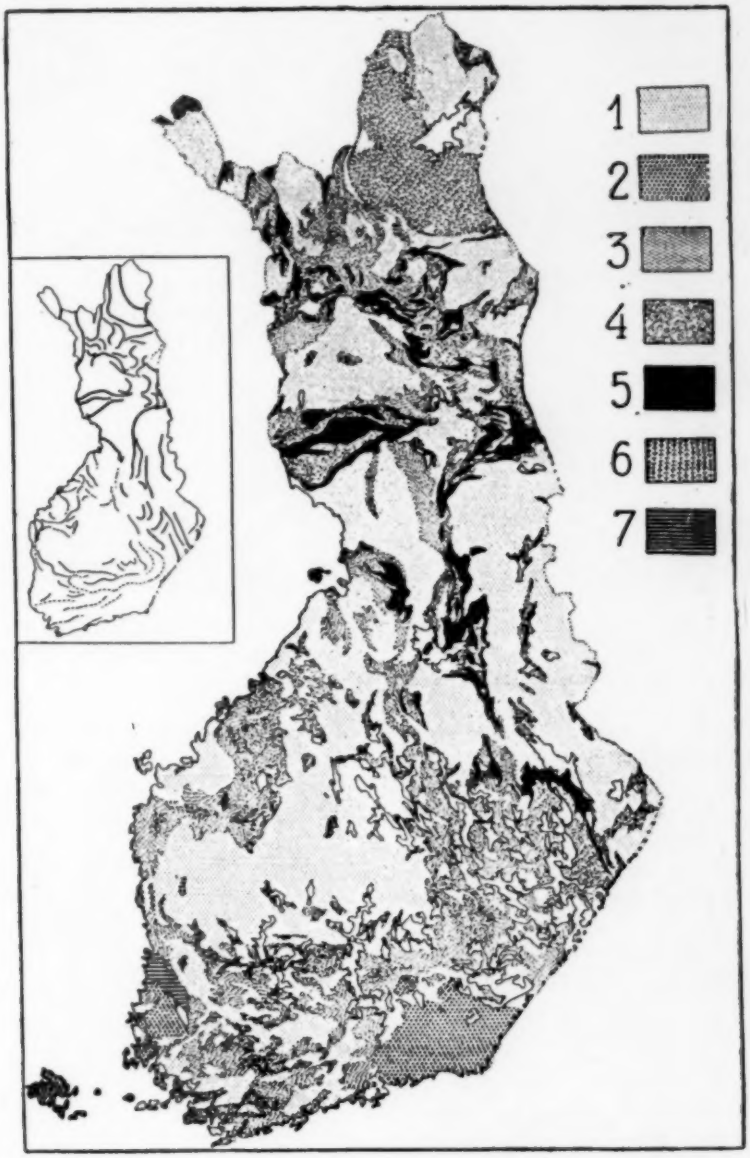

Fig. 2. GENERAL GEOLOGICAL MAP OF FINNISH BEDROCK.

1. Granite, gneissose granite.
2. Rapakivi granite.
3. Veined gneiss.
4. Mica schist and mica gneiss.
5. Quartzite, arkose, conglomerate.
6. Granulite.
7. Cambro-Silurian formations.

Insert map showing the main trends of the bedrock

Fig. 3. LAKE AND ESKER SCENERY. PUNKAHARJU.

formerly prevailing deep in the Earth's crust.

PLEISTOCENE DEPOSITS*

The loose deposits of Finland belong to the formations of the Quaternary or Pleistocene period. As a thin bed they cover the deeply eroded and peneplained Pre-Cambrian bedrock, the primary weathering products of which are only found to some extent in Lapland. The predominant sediment is moraine mainly eroded and ground away from the fresh bedrock by inland ice. Pre-Glacial weathering products in moraine are very scarce for inland ice carried them outside Finnish territory. The stones in the till are granitic like the bedrock. The glacigenous erosion forms and striation of the bedrock as well as the orientation of stones in till indicate that the average direction of glacial flow ran from the northwest to the southeast. Striae of various ages and trend, however, also occur locally, but for the present it is not yet clear, whether they only indicate a relatively short difference of age or whether there are possible interstadial or interglacial phases between various movements of ice flow. It seems probable that they belong to the same ice age. Positive interglacial formations have not yet been found in Finland.

The average thickness of moraine is only 2 to 3 meters so that topography is generally influenced by the form of the bedrock. The post-Glacial fluvial erosion has only been able to cut the moraine to a rather small extent, with the result that the water table generally lies high in the Finnish soil. In addition, as moraine is weakly permeable it is understandable that the morainic depressions are

*by Dr. E. Hyyppa, Chief of the Department.

paludificated.* About a third part of the Finnish territory is covered by bogs representing an amount of peat of some 120 billion cubic meters, a considerable part of which is suitable for fuel.

In addition to moraine, there are the eskers and other glaciofluvial formations typical of the Finnish landscape. The eskers of south Finland have been formed under subaquatic circumstances, while the Lappish eskers are supra-aquatic. However, the eskers of both areas are often morphologically and structurally of the same type. A satisfactory explanation of the genesis of eskers has not yet been found and it seems most probable that also in Finland they have been formed in various ways. Among the glaciofluvial formations the Salpausselka ridges (the I and II Salpausselka), running from south western Finland to northern Karelia, attract special attention. They are typical marginal formations built up in front of inland ice, the building being assisted by the late-Glacial sea. Contrary to popular belief, there is not much moraine in these formations, their material being for the main part sand and gravel.

At the close of the Ice Age in Finland about 10,000 years ago, the whole of Fennoscandia lay deeper than at present. It has been estimated geophysically that inland ice at the center of the depression area would have been some 2650 meters in thickness causing a depression of 730 meters in depth. The land evidently started to rise even during the late-Glacial period and 210 meters at the center of the upheaval would still be left now. The present upheaval of land in the neigborhood of Helsinski is 30 to 40 centemeters in a century, and 100 centimeters

*(Ed.: turned into marshes.)

Fig. 4. Section through esker. Varpaisjarvi.

at the end of the Gulf of Bothnia.

The inland ice retreated, and its melting border was followed by the ancient Baltic Sea, then covering the greatest part of Finland. The highest ancient shores lie 250 to 300 meters above the present sea level. The development of the Baltic is very complicated and its study is still unfinished. The so-called Littorina phase about 5000-2000 years B. C. can be regarded as finally explained. The Ice Age had come to an end already 2000 years earlier, and the post-Glacial climate was at its optimum during the Littorina period. During the warm period rare deciduous trees were growing in abundance in the Finnish forests and many Central European species throve there. About 2000 B. C. the climate began to deteriorate and develop into its present state. Simultaneously strong paludification started and the forests became predominantly coniferous. The history of the climate and forests in Finland has in recent times been studied with the aid of micro- and macroscopic remnants of plants preserved in the peat layers of bogs. Quantitative pollen analysis, especially, has proved important.

Apart from the ancient shore marks, the clay deposits of South and West Finland containing remnants of marine organisms also prove that Finland has risen from the sea after the Ice Age. The

Fig. 5. The open, cultivated landscape with wooded rock islets, typical of south-western Finland. Karjaa.

oldest clays are the so-called varved clays reflecting in their structure, like the annual rings of a tree, the succession of seasons. The post-Glacial clays are for the main part those of the Littorina sea, generally without varvity. Both kinds of clay can be used as material for the ceramic industry and the varved clays particularly are very suitable for the brick works.

USEFUL MINERALS

It is possible to find various occurrences of minerals of economic importance, particularly ores, in the bedrock described above in general features. But this bedrock is entirely devoid of such ores as are met with in the non-metamorphic rocks of the younger geologic formations. Consequently, coal, brown coal and naphtha are not found in Finland. The Finnish bedrock does not contain salts, gypsum, bauxite or phosporite. The ores found up to the present are typical of the ores of the commonest heavy minerals generally occurring in countries of Archean rock. In addition, this kind of bedrock is characterized by limestone, soapstone, asbestos, feldspar, quartz, graphite and granites for building- and monument-stones, etc.

Iron ores. From time immemorial iron has been dredged from lake and bog iron ores, but in our days this kind of material has only been used in war time. The most important bed of iron ore at present is Otanmaki, south of Lake Oulujarvi, discovered by the Geological Survey in 1938. The ore is a titanium iron ore, but its valuable minerals ilmenite and magnetite

Fig. 6. OUTOKUMPU COPPER MINE.

occur as separate crystals, so that ilmenite and magnetite concentrates are obtainable by an electromagnetic process. The working of this large occurrence is being projected. Burnt tailings of sulfide ores, of 100,000 tons annually (60 per cent), have in recent times been the only source of Finnish iron ore.

Sulfide ores. The most important sulfide ore bed is Outokumpu discovered by the Survey in 1910. The occurrence contained about 25 million tons of copper ore, of which already 7 million tons have been extracted. The average ore content is as follows: 3,5 per cent copper, 25 per cent sulfur, 28 per cent iron, 1 per cent zinc, 0.2 per cent cobalt, 0.1 per cent nickel and 40 per cent SiO_2, and besides 0.8 gr. of gold and 10 gr. of silver per ton. Annually 700,000 tons of ore are extracted at Outokumpu. The copper concentrates are smelted utilizing the heat of oxidation of its sulfur, and this in addition generates power for other needs. The Outokumpu copper refinery is in this respect the only one in the world. All products are refined in its own plant.

Besides Outokumpu there are 4 or 5 other mines of sulfide ores in the country, two of them being discovered by the Survey, but they are of minor importance.

Washed gold. Gold has been washed for about 80 years out of the river gravel in the Ivalojoki district. The washing has mainly been done by hand because of the smallness of the occurrences and the coarseness of the gravel. The yield has always been small and the gold fever has rapidly fallen, so that only a few dozen people, enraptured with the Lappish wilderness life, continue their work there.

Non-metallic minerals. The most important of these is asbestos, which is being quarried at Paak-

Fig. 7. LIMESTONE QUARRY. PARAINEN.

kila in Tuusniemi. This asbestos is amphibolic and its use is more restricted that that of serpentine asbestos, but because of its great fire-proof qualities it is suitable for many purposes, being sometimes better than serpentine asbestos. Asbestos is exported.

Potassium feldspar and quartz are quarried out of some granite — pegmatites. They are so coarse-grained that feldspar and quartz can be selected by hand. The supply of these minerals covers domestic needs and feldspar is also exported.

There are some large occurrences of limestone and dolomite. The layers are usually vertical or of steep inclination. Limestone is obtained not only out of open quarries, but also from mines. Its quality is good. Limestone of high grade (for the glass industry) is being exported, but the main part is used by the cement and lime industry. In 1949 about 1.5 million tons of limestone were quarried, the amount of cement produced being some 1.6 million tons.

Other useful rocks. Soapstone is found in the schist area of East Finland forming in places such thick layers that it can be quarried for use as refractory linings in soda kilns of the pulp mills, and for the making of stoves, etc. It is very fire-proof and in addition withstands fused lye, being therefore suitable for the above-mentioned purposes. On account of its softness it is used for ornamental purposes.

Granites and other hard-building- and monument-stones are quarried in many places. Owing to Finnish geological conditions these rocks are quite fresh and unweathered. The weathered surface was completely worn away during the Ice Age, and weathering in the post-Glacial period has not generally reached more than a depth of one centimeter, and on the coast where the bedrock has been submerged for a long time it is still less. Before the war our red and grey granites has a good reputation and they were exported as far as Australia. Owing to the present poor economic conditions of the world as well as to license restrictions, this export has declined.

The Geological Survey is also the State Prospecting Institute and in addition investigates useful occurrences. The most numerous and important of the Finnish ore mines were discovered and investigated by the Survey, but the researches were started on the basis of a boulder sent by a country man. The prospecting method at present is as follows: The Geological Survey promotes general

prospecting by turning to the public through newspapers, periodicals, radio, and by promising rewards in order that people will send stones throught to be ores to the Survey. Such samples are being received in abundance, but only a few of them give rise to investigation in the terrain and still fewer lead to discoveries. An ore boulder having been found, the work of the prospecting geologists begins based on local geology and the use of geophysical methods. The source of the boulder may be situated nearby, at a distance of 1 to 2 km., or some dozens of kilometers farther away. When an ore bed has been found excavations or borings are commenced and finally its economic value calculated.

Non-metallic as well as other useful minerals are prospected and investigated partly by the aid of similar methods, and partly by quite different means.

In war time the geologists rendered military service and the work of the Geological Survey ceased almost entirely for many years. Three geologists and some summer assistants gave their lives in defense of their country. The Survey building was twice damaged by bombing, interrupting the work until repairs were made. But the loss to Finnish geology, deprived of its three talented geologists, cannot easily be retrieved. Only time and continued work will fill the void made by death.

PLEISTOCENE MAN IN NEW MEXICO

HERBERT B. NICHOLS
U. S. Geological Survey

New light has been shed upon the succession of human inhabitants of New Mexico in the late Pleistocene Era through recent studies of artifacts from the Southwest reported at the annual meeting of the Geological Society of America. Dr. E. H. Sellards, Director of the Texas Memorial Museum told of 1949 and 1950 excavations in the Clovis-Portales Region of Eastern New Mexico.

It has been quite generally accepted among anthropologists that North and South America were peopled by migrants from northeastern Asia who arrived in small groups while great sheets of glacial ice still covered the northern land areas and mammals now extinct were still to be found. But from this point on there is a vast gap in our knowledge of primitive man in the Western world, a gap bridged only by the occasional discovery of unusual weapon points and other artifacts.

These excited little interest until in 1925 and again in 1927 archeologists found some of these points definitely associated with an extinct bison near Folsom, New Mexico. Thus were "Folsom Man" and "Folsom points" distinguished from the usual type of arrow and spearheads found in the southwest. Characterized by their length, delicacy and fine workmanship with a longitudinal groove chipped out of each side, the points were found also near Lindenmeier in Colorado. No skeletal remains of these spectre-like people have yet been uncovered.

Dr. Sellards' paper adds in an important way to knowledge of the relative age of the early human cultures in America, particularly those of the great interior plains region. The locality described is

the first to be found showing clearly the relative geologic position of three of the early plains cultures. The deposits that were excavated are in a small lake or spring head that filled by deposits accumulating intermittently, resulting in four distinct horizons superimposed, three of which contained human relics and fossil remains.

The basal member of the lake fill, a gray sand, contains additional to the artifacts fossil remains of elephant, horse and bison. The second member, consisting of dark sand, contains fossil animal bones but, so far as known, no artifacts. The third member, a deposit consisting largely of minute plants and diatoms, contains bison and no elephant or horse. The fourth member of the lake fill, consisting of gray and dark sand, contains artifacts and an abundance of buffalo remains.

The fact of major importance brought out in Dr. Sellards' paper is that the culture of the basal stratum of lake fill is distinct from and older than the well known Folsom culture which occurs in the third horizon of the lake fill. To this culture the author has given the name Llano, that is, Plains Culture, because of its having been found in the Llano Estacado region of Texas and New Mexico.

Notable characteristics of the culture are the extensive use made of bone implements, more artifacts made of bone having been found than those made of stone. The bone implements are of several different kinds, some are long and pointed and other are a few inches in length and pointed at one or both ends implying that they were used as hand tools in digging. It is inferred that the shallow lake at that time supported a growth of tuberous plants and that the digging was for the purpose of getting such tubers.

Among the stone artifacts is a hammerstone battered by use and on the two sides smoothed, possibly by having been used to grind the harder plant seeds for food. The implications are that these earliest known people of the plains obtained a part at least of their food from seeds and tubers and were not wholly a hunting people.

That they engaged in hunting, however, around the small lake is proven by the presence of stone projectile points such as would be used on darts or spears and also hide scrapers made of stone. Projectile points of this kind had previously been found at this lake and at many other localities throughout the United States and parts of Canada. At several localities such points have been found in immediate association with skeletons of elephants from which it is inferred that these people hunted the elephant.

These points are known to archeologists as Clovis - fluted points from their occurrence in the Clovis-Portales area. That these points were older than Folsom had previously been suspected by some archeologists. They are known to occur associated with elephant remains not only in the Clovis-Portales region but also at four other localities: Dent, Colorado; Angus, Nebraska; McLean site, Abilene, Texas; and Cowan Ranch, Miami, Texas. As surface finds this type of point is widely distributed.

The proof that the Llano culture described in this paper is older than Folsom is the fact that its stratigraphic position is directly under the Folsom horizon of the lake fill.

That it is considerably older is implied by the fact that the Llano culture stratum is separated by a

disconformity from the overlying brown sand and the brown sand stratum in turn is separated by a similar break in sedimentation from the diatomite stratum that holds the Folsom culture. The amount of time in years represented by the two breaks in deposition is not known at the present time, but it is likely to be considerable when measured in centuries.

Likewise, the age of the Llano culture in years cannot be determined until more information has been secured. On the basis of geologic considerations it is believed to be not less, but probably more, than 10,000 years old.

The Folsom culture of stratum 3 of the lake fill is distinctive and includes projectile points and scrapers. Of seven points obtained from this level, one, although presenting the form and workmanship of the other Folsom points, lacks their usual deep fluting. All occur among bison bones and are more or less battered by use. The fourth stratum of the lake fill contains a greater abundance and also a greater variety of artifacts than the older horizons. The artifacts of this level are of the kind that has commonly been classed within the range of the Yuma cultures.

The fourth horizon is separated from the underlying deposits by a break in sedimentation. These several interruptions in the filling of the small lake can be satisfactorily accounted for only by changing climatic conditions indicating successive wet and dry periods. The rainfall of this area is now around 20 inches per year and under these conditions the ground water level is below the old lake bed level. At the time each of the four units of deposition formed, the lake necessarily held water.

The fluctuation in rainfall in past centuries is, therefore, the most likely explanation of the interruption of human habitation recorded in the sediments that have been accumulated in the lake bed.

FIND BONE OF SMALLEST MAMMAL KNOWN IN AMERICA

NEW YORK, Nov. 17 (Science Service) — The smallest mammal ever known in America has been identified from a three-sixteenth-inch piece of jawbone found in Wyoming. The animal was a tiny shrew which lived 55,000,000 years ago.

The discovery was announced here by Dr. George G. Simpson of the American Museum of Natural History and Dr. Paul O. McGrew of the University of Wyoming, co-leaders of a fossil-hunting expedition this summer in the Green River Basin.

Other fossils brought back in an extensive collection include the remains of opossums no larger than today's house mouse, birds, and fish.

These creatures lived during an age when the West was also inhabited by huge mammals, and there were fresh water lakes over vast areas which are now range land.

DISCOVER THIRD DEPOSIT OF BRAZILIANITE

LOS ANGELES, Nov. 13 (Science Service) — Previously known to exist in only two places in the world, a third deposit of the rare mineral brazilianite was announced today.

Crystals of the clear, slightly greenish mineral were found recently in old mine cuts in northeastern Brazil by Dr. Joseph Murdoch, professor of geology at the University of Los Angeles.

Before this discovery it was known to exist only in south central Brazil and in New Hampshire. Tiny crystals of the mineral were located in old tantalite and beryl mines in the state of Paraiba, Brazil, which had been active during World War II.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

PETROLOGY, PETROGRAPHY, MINERALOGY, ETC.

THE AQUEOUS EMANATION FROM PARICUTIN VOLCANO. W. F. Foshag. **Am. Mineralogist,** v. 35, nos. 9-10, p. 749-755, Sept.-Oct. 1950. "An estimate of the quantity of water emitted by the crater vent of Paricutin volcano gives 17,000 tons per day, compared to an average daily emission of lava of 100,000 tons from the lava vents. This quantity of water is believed to be larger than the amount of water one could reasonably expect from the magma rising in the eruptive conduit, and suggests a considerable dilution of magma emission by vapors derived from meteoric waters. The apparent differences between crater vent and lava vent emissions bear out this idea. . ."

THE MAKING OF A MAGMATIST. Norman L. Bowen. **Am. Mineralogist,** v. 35, nos. 9-10, p. 651-658, Sept.-Oct. 1950. "Professor Larsen's studies of lavas, minor intrusions, and batholiths in the San Juan region of Colorado and in Southern California are presented as the basis of his development of magmatist views.* Anti-magmatist views on the formation of batholiths are discussed, and also the magmatist view that batholits are formed by refusion in a tectogene**."

RADIOACTIVITY AND MINERAL DEPOSITS. N. B. Keevil. **Am. Mineralogist,** v. 35, nos. 9-10, p. 816-833, Sept.-Oct. 1950. "Radioactivity is important in a variety of problems in economic geology. Radiation from radioactive ore deposits provide a means of locating shallow ore-bodies. Anomalous distribution of radioactivity also may be of limited use in locating faults. Variations in radioactivity of ordinary rocks are proving useful as a means of correlating rocks, and of logging cased wells, and radioactivity produced in the more common rock-forming elements by artificial neutron bombardment likewise is proving useful as a logging method. Studies of rocks show an increase in the proportion of radioactive elements in differentiation from basic rocks to granites and pegmatites, and have provided some insight into the mechanism of formation of radioactive ore." The helium and lead methods for the calculation of geological age are discussed. "Studies of the radiogenic and isotopic history of lead ores suggest that hydrothermal ores of this type are derived from rocks or rock magmas."

REMARKS ON CRYSTALLOGRAPHIC NOMENCLATURE. M. A. Peacock. **Am. Mineralogist,** v. 35, nos. 9-10, p. 882-888, Sept.-Oct. 1950. "In special cases the lattice (not structure) of a crystal in any system may be indistinguishable from the lattice typical of any higher system. Thus it is formally better to define and name the systems on the basis of symmetry (as groups of classes); for this purpose a set of self-explanatory names and symbols is proposed."

*(Ed.: The Sept.-Oct. **American Mineralogist,** "Studies in Petrology and Mineralogy", is "dedicated to Esper S. Larsen, Jr., Professor of Petrography, Harvard University — 1923-1949 — by friends and former students".)

**(Ed.: a crustal buckle.)

ROCK-MAGMA AND ROCK-SPECIES. S. J. Shand. **Am. Mineralogist,** v. 35, nos. 9-10, p. 922-930, Sept.-Oct. 1950. "A discussion of two fundamental petrologic terms. The word **magma** has lost its former physical significance and become a mere sack-name for any hot silicate fluid. This has led to misunderstanding of the actual physical state of the igneous fluid at the moment of intrusion or extrusion. The extravagant multiplication of rock names leads the writer to offer a definition of **rock-species** and to advocate the use of phase-petrology."

TRACE - ELEMENT STUDIES, SANTA RITA, NEW MEXICO. Donald L. Graf & Paul F. Kerr. **Geol. Soc. Am. Bull.,** v. 61, no. 10, p. 1023-1052, Oct. 1950. "Emission spectrography has been used to study distribution of trace elements in Paleozoic limestones surrounding Pb-Zn ore bodies near Santa Rita, New Mexico, and subsequent transportation of these traces into overlying Tertiary beds. Analyses are given for Pb, Zn, Cu, Ag, and V, important ore metals, and Mn and Al, prominent in pre-ore silication." The authors conclude that Pb is an ideal tracer element in all areas. "Trace element studies appear to represent a logical and more precise extension of present techniques for inspecting fault gouges, and searching for mineralization along faults and joints."

THE WATER CONTENT OF PRIMITIVE GRANITIC MAGMA. Earl Ingerson. **Am. Mineralogist,** v. 35, nos. 806-815, Sept.-Oct. 1950. "Previous estimates of water content of magmas are summarized. Assuming that essentially the amount of water now on the Earth's surface was in a primitive atmosphere and that this atmosphere was in equilibrium with a molten outer layer of the Earth as it began to crystallize, the amount of water in this 'primitive magma' can be calculated. It comes out about 3%."

British Columbian Volcano Partially Built On Glacier

WASHINGTON, Nov. 16 — A volcano which covered a glacier in British Columbia about 35,000 years ago while it was first in eruption, was described today by Professor W. H. Mathews of the Department of Geological Sciences at the University of California, Berkeley, California.

Mount Garibaldi, one of a chain of remarkable volcanoes in the mountains of southern British Columbia, began with eruptions along the crest of a mountain ridge which at the time was surrounded by glacial ice. In some ways its origin was similar to Paricutin, which has grown out of a Mexican cornfield in recent years. But the eruptions were more like those of Mount Pelee in the West Indies, which many years ago snuffed out the lives of 30,000 people in a few minutes.

As the volcano grew, Prof. Mathews recounted in a research abstract submitted to the Geological Society of America, the hot ash and cinders covered the ridge and spread out onto the glaciers which occupied the adjacent valleys. At its maximum size, the base of the volcanic cone was 4½ miles in diameter. Later, when the climate became warmer, that portion of the cone which lay on the ice collapsed into the valleys.

A second period of volcanic activity by Mount Garibaldi is also revealed from geologic evidences in the area, but this occurred after the glaciers had melted. The dome is now being slowly destroyed by landslides, torrential streams and frost action.

LAST ADVANCE OF ICE SHEET PLACED AT 11,000 YEARS AGO

The date of the last great period of glaciation in the northern hemisphere has been moved up to within 11,000 years ago, Prof. Richard Foster Flint of Yale University reported before the geomorphology section of the Geological Society of America's 63rd annual meeting.

For the first time, he said, "it is possible to determine the exact dates, within small limits of error, of events that occurred at any time up to nearly 20,000 years ago — provided you have a piece of wood, some charcoal, or a specimen of peat taken from geologic deposits made at the time in question. This is possible thanks to radiocarbon, a carbon isotope known as C^{14}. Radiocarbon takes the guesswork out of dates that formerly had to be estimated with varying degrees of inaccuracy.

"The radiocarbon method of dating has been developed by W. F. Libby, J. R. Arnold, and their associates at the University of Chicago. Collaborating with them has been a committee of four appointed by the American Anthropological Association and the Geological Society of America. The Committee consists of Frederick Johnson (chairman), of Peabody Foundation, Phillips Academy, Andover, Mass., Donald Collier, of Chicago Natural History Museum, Chicago, Ill., Froelich G. Rainey, of University Museum, Philadelphia, Pa., and Richard Foster Flint, of Yale University, New Haven, Conn. The Committee provided and evaluated the samples for analysis.

"Carbon 14 is radioactive. It is present in the atmosphere and in all living organisms in fixed proportion to ordinary carbon, because as long as an organism is alive the carbon in its substance exchanges freely with atmospheric carbon, in the form of carbon dioxide.

"But when the organism dies this exchange ceases, and as C^{14} is radioactive, it disintegrates at a rate that continuously decreases, and thus its amount in the dead substance diminishes with the passage of time. In about 5,568 yeras it is half gone. In about 20,000 years it is almost all gone.

"By measuring the rate of disintegration with a Geiger counter it can be learned how long ago the organism died. Pieces of wood from ancient Egyptian tombs were dated in this way and the dates agreed closely with those inferred from historical records.

"One of the dates important to geologists is the date when the great North American ice sheet flowed over northern United States for the last time, reaching as far south as Buffalo, Saginaw, Milwaukee, and Minneapolis. It has been estimated that glacier ice stood along this line 25,000 years ago, and then began to molt away. A startling result of radiocarbon tests is that this vent took place only about 11,000 years ago. Here is the way the date was determined:

"In a Lake Michigan bluff in northern Wisconsin is exposed a layer of peat directly overlain by the earth and stones deposited by the glacier ice sheet just before it reached the limit of its last great push. The peat was studied by Professor L. R. Wilson of the

University of Massachusetts who found that it represents a former swamp in which spruce trees grew. The trees consisted only of stumps rooted in place, and logs snapped off and splintered at their bases, all of them pointing southwest, the direction in which the glacier is known to have moved.

Growth rings showed that during the last dozen years in the life of each tree the growth had been very poor. This meant that the advancing glacier created cold, wet conditions at that place for at least twelve years, and then like a giant bulldozer it overrode the whole forest.

"Radiocarbon tests show the peat is 11,400 years old, and it is estimated that the glacier ceased it advance and began to melt a little later — in round numbers about 11,000 years ago.

"Similar deposits of peat from Ireland, England, and Germany, which likewise preceded a glacial advance, were dated and found to be very nearly the same age as the one in Wisconsin. This leads to the belief that the chilling of the climate that sparked the last glacial push was not local but was general over Europe and North America. In this way radiocarbon dating of many more samples should provide a world climatic history of the last 20,00 years."

The June 1950 Eruption of Mauna Loa

HERBERT B. NICHOLS
U. S. Geological Survey

Though Mauna Loa's fiery cauldron had spilled over in 1949, volcanologists at the Hawaiian Observatory noting in May 1950 that the mountain was still tumescent and restive, suggested another outbreak was likely and predicted that if an eruption did come soon it would be on the southwest slope.

At the 63rd annual meeting of the Geological Society of America, R. H. Finch, Gordon A. Macdonald, and G. D. Robinson of the U. S. Geological Survey presented a joint report on the June 1950 Eruption of Mauna Loa, when a rift 13 miles long appeared on the southwest flank. It produced the second largest flow of lava from this volcano in recorded history.

The paper was delivered orally by Mr. Robinson and the following notes were furnished by Mr. Finch, volcanologist at the Observatory in Hawaii National Park:

"Mauna Loa is a volcano 13,680 feet high near the center of the island of Hawaii. During the last 125 years it has averaged one eruption every 3½ years. The northeast and southwest flanks of the mountain are marked by fissure systems. Eruptions of the mountain occur along these fissure systems and from the summit crater.

"At 9:04 the evening of June 1, 1950, the southwest rift of Mauna Loa split open for a distance of approximately 1½ miles, liberating floods of fluid lava, and sending a great mushroom-shaped fume column several thousand feet in the air. The initial break was between 11,000 and 12,000 feet altitude. Activity there lasted only about 4 hours. About 10:15 p.m.

another fissure opened lower on the rift, liberating clouds of fume, and at 10:33 liquid lava reached the surface. The total extent of cracking was about 13 miles, but only three isolated major portions of the fissures liberated lava. Besides the early upper outbreak, lava poured from 1.7 miles of fissure centered at 10,000 feet, and from 3 miles of fissure between 8,000 and 9,000 feet. Subsidiary fissures lay east and west of the lower main fissure. For the first few hours continuous curtains of lava fountains played as much as 300 feet in the air along the fissures. Six major lava flows were produced, three of them entering the ocean on the west side of the island after crossing the road. The lava was pahoehoe (smooth, ropy, or fluted surface) at the vents, but most of the major flows were aa (jagged and cindery). Estimated speeds of flow in the main channels reached 35 miles an hour, and the front of the major flow which destroyed part of Hookena Mauka village advanced down the mountainside at an average rate of 5.8 miles an hour. Temperature of 1,030° to 1,070°C. were observed at the vents, and 840° to 970° on the incandescent surface of the lava river 11 miles from the vents.

"The provisional estimate of the volume of lava poured out in 1950 is 500,000,000 cubic yards. This estimate makes it the next largest lava flow from Mauna Loa in recorded history.

"After the end of the 1949 eruption the magma in the Mauna Loa conduit appears to have continued to stand at high level. Fuming continued in the summit caldera through the rest of 1949 and the spring of 1950. During the spring of 1950 westward tilting of the ground at the Hawaiian Volcano Observatory was distinctly less than usual, apparently indicating tumescence of the mountain. Eastward tilting began about the middle of March, two to three months before the average date of beginning of the seasonal eastward tilt. Apparently this resulted from an increase in magmatic pressure beneath Mauna Loa.

During the last 100 years flank eruptions have come on the average 18 months after summit eruptions, and consequently it was expected that the 1949 summit eruption would be followed by a flank eruption within two years. The apparent high position of the magma column suggested that the interval might be shorter than average. During May the Volcano Observatory recorded 102 earthquakes most of which originated at Mauna Loa. (The usual recorded per month is about 30.) The numerous earthquakes indicated distinct uneasiness of the southwest rift near the summit, close to the point where the initial outbreak of the eruption later occurred. On the basis of this a bulletin from the Volcano Observatory, published in newspapers on May 30, called attention to the unrest of the volcano and predicted that if outbreak came soon it would be on the southwest rift. The expected eruption came on June 1."

NORTHERN MEXICO ONCE HAD MOIST CLIMATE

WASHINGTON, Nov. 16 — Extensive swamps occupied considerable parts of presently dry northern Mexico about 15,000 years ago, Dr. A. R. V. Arellano of the Geological Institute of Mexico reported today. He revealed in a research report submitted to the Geological Society of America, gathered in Washington, D. C., for its 63rd Annual Meeting, that peat layers furnished the evidence.

DIASTROPHISM IN THE HIMALAYAN MOUNTAINS

PETER MISCH
University of Washington

The latest episode in the crumpling and displacement of the earth's crust which has produced the highest and most extensive mountain ranges on our globe occurred last winter with the very serious earthquake in Asam, Prof. Peter Misch of the University of Washington told the Geological Society of America at its 63rd annual meeting.

Folding and uplifting of the first Himalayan ranges occurred about forty million years ago but has continued intermittently ever since. In places shortening of the earth's crust has actually caused the mountains to move southward toward India.

Recently while studying the geology of the northwestern part of the Himalayans, Professor Misch found evidence of large scale uplifts of rather recent date. These indicated that not only had the southern part been recently deformed but the main portions of the Himalayan system itself showed evidence of extensive crustal deformation.

Geological investigations near the towering glacier capped peak Nanga Parbat reveal that sediments deposited probably less than one million years ago have been folded between gigantic earth masses. The uplifts on either side have left the upper valley of the Indus River in places as much as 15,000 feet below the tops of the dislocated blocks.

Part of the evidence lies in the presence of old stream eroded plains now forming the tops of high plateaus. Because the earth's crust has been broken into great blocks by faults, the remains of this old plain now lie at elevations which differ by many thousands of feet. This suggests that a few thousand years ago this portion of the Himalayan system was a relatively smooth surface subsequently broken into blocks raised to different elevations.

As a result of these local and regional uplifts, the streams in the area have cut magnificent canyons. The character of these canyons gives further evidence that the area is still rising.

From the point of view of geologic history, the observations made imply that we ought to distinguish between an original Himalayan chain which came into existence as a result of the main folding and associated uplife in earlier Tertiary time and which in late Tertiary time was considerably worn down by erosion, and a reborn Himalayan chain which has been created since the latest Tertiary by renewed crustal movements consisting chiefly of partly differential and partly general intense uplift, and a much less extent of true folding.

In the Southeastern prolongation of the interior zones of the Himalayan system, there are conditions comparable to those in the Northwestern Himalayas. The region studied is in Northwestern Yunnan, near the boundaries of Burma, Tibet and China, and was almost unknown geologically. It is located where the more easterly Himalayan ranges turn sharply to the South. Here the outer zones of the Himalayas are continued by the folded mountain chains of Western Burma, whereas the

interior zones have their counterpart in the high ranges of the Burmese-Chinese frontier and of Western Yunnan. The intense main folding in the interior belt of Western Yunnan was found to have occurred in the Mesozoic (age of dinosaurs), so it antedated that in the Himalayas.

With the prominent Mesozoic folding, a circum-Pacific element enters into this North-South trending portion of the greater Himalayan system. The Mesozoic mountain ranges of Northwestern Yunnan had been worn down to a surface of moderate relief in late Tertiary time. During the Pliocene, numerous lake basins formed on this surface, probably as a result of gentle warping associated with minor faulting. The lakes were filled with clay, silt and sand.

As in the Northwestern Himalayas, this period of comparative peace was succeeded by powerful late Cenozoic differential uplift. The crustal movements began at the end of the Pliocene, their first beginning being recorded by a general coarsening of the basin sediments. The movements reached their climax soon after the end of the Pliocene, and continued through the Quaternary. The differential character of the uplift was as pronounced as in the Northwestern Himalayas, but the mechanism was faulting rather than warping and folding. Folding occurred only locally, as recorded by the Pliocene sediments. The area became broken up into North-South trending fault blocks, including both the tilted fault block type and the type of block with faults on both sides.

The result was basin and range structure, recalling that of the Great Basin and other parts of the North American Cordillera. One difference is that in Northwestern Yunnan the ranges occupy considerably more area relative to the basins than is the case of the Great Basin. This distinction is to a limited extent connected with another important difference: in the Great Basin the absolute movement of many of the basins has been downward though the ranges have generally moved upward; but in Yunnan both basins and ranges have suffered an absolute upward movement and the basins are merely blocks which have lagged behind the ranges during the process of differential uplift of the entire area. Consequently the basins are at high elevations, generally ranging from about 5,000 to considerably over 8,000 feet; frequently they are thousands of feet above the bottoms of neighboring river canyons. Most of the Pliocene sediments preserved are in the fault basins, but some remnants of Pliocene deposits were found high up in some ranges.

The magnitude of these differential vertical block movements is very great. The uplift of the ranges relative to adjacent basins often approaches, and in some cases exceeds 10,000 feet. The greatest relative uplift was observed between the Big Snow Mountain (elevation not exactly known, being between 21,000 and 23,000 feet) and the Likian Basin (8,600 feet). If it is taken into account that relative to sea level the basins have also been uplifted thousands of feet, even larger figures are obtained for the absolute uplift of the ranges in post-Tertiary time, that is in the very recent geological past. Generally in Yunnan the magnitude of modern uplift was found to increase toward the Northwest, that is toward the Eastern end of the Himalayan chain proper. The figures given above apply to Northwestern Yunnan. They are comparable to those

obtained in the Northwestern Himalayas.

The late Cenozoic geological history of Northwestern Yunnan could also be described in terms of an overall uplift of the entire area with differential movements of the block type being superposed. The overall uplift has led to a powerful general rejuvenation of erosion. This general rejuvenation manifests itself most strongly in the exceedingly deep and narrow canyons of the great rivers of the area, and of the lower courses of their tributaries. The upper courses of the smaller rivers have not been reached by the overall rejuvenation yet, and generally have preserved broad and open mature valleys inherited from the relatively quiet times preceeding the late Cenozoic crustal movements, but now occurring at elevations high above those at which they were originally formed. In the rejuvenated valleys, vertical erosion is proceeding at a rapid rate today.

Differential uplift of ranges relative to adjacent basins has led to powerful local rejuvenation of erosion, the basin acting as local base level. The resulting landforms are mostly very steep, especially where—as in most cases — the boundary between basin and range is a youthfully dissected fault scarp. In the higher parts of the most ranges, remnants of an earlier mature topography have been widely preserved at various levels, though parts of some of the highest ranges have been dissected into sharp aretes, especially where the range has been attacked by general rejuvenation from a river canyon on one side and by local rejuvenation from a high basin at its faulted opposite side.

Evidence of differential uplift, apparently of the warping variety and of rather recent date, has in a few cases been found in larger river canyons. In these cases the river displays a more sluggish area with shifting gravel bars above, and rapids in an extremely narrow canyon below, the canyon cutting across a mountain range which appears to have been uplifted more strongly than the vicinity.

The most impressive case of this kind is the canyon the Kangtzekiang has cut through the mountain massif, the East part of which is known as the Big Snow Mountain of Likiang. On the face of it, the behavior of the great Yangtzekiang in this area does not seem to make sense. The river is flowing southward, coming out of Tibet, then sharply turns to the north, although a broad valley continues to the South only about 2,000 feet above the present level of the river; but the river heads northward instead, right toward the highest mountain massif of the region, and cuts a canyon about 15,000 feet deep right through the core of this massif. The explanation lies in the history of this part of the Kangtzekiang. It used to continue southward during the later Tertiary, just like its brothers, the Mekong and the Salween. Then its course became deflected to the north through capture proceeding along a northern tributary which, on its part, had been captured by a southward flowing river further to the northeast. All this took place in late Tertiary time before the great mountains of Likiang were in existence. Then the late Cenozoic crustal disturbance began, and the mountain mass began to rise. The powerful river was able to keep up with the uplift, cutting its tremendous gorge.

As mentioned above, the late Cenozoic crustal movements in

Northwestern Yunnan had their climax after the end of the Pliocene, but there is evidence that both overall uplift and some differential block movements have been continuing into modern times and at least in some places, are still going on. In other words, here also the mountains are still growing. Evidence for several thousand feet of late to post-Pleistocene vertical erosion was found in the canyon of the upper Mekong. The evidence consists of dissected remnants of glacial moraines which occur at the mouth of a tributary on spurs forming part of a clearly marked old valley floor of the Mekong. Into this old floor the present canyon has been cut to a depth of several thousand feet. Entirely similar conditions were observed in the great canyon of the Yangtzekiang, described above although here no remnants of moraines have been preserved on the spurs.

Evidence of modern faulting was found in a few places. One example involves presumably late Ice Age gravels unconformably overlying tilted Pliocene which have been uplifted about 2,000 feet along a fault. In another example, Ice Age gravels have been faulted at the East foot of the high range of Tali. At another place a recent fault scarplet not yet affected by weathering was found in bedrock.

The east slope of the high Tali range just mentioned is a great fault scarp. There is seismic evidence that this fault is still active today. Earthquakes frequently occur at the boundary of the range and the adjacent basin, and in the early 1920's several towns situated close to the foot of the range were in large part destroyed by a violent shock which had little effect farther away from the fault. Seismic activity is recorded from other parts of the area also. And, of course, everybody has heard of this year's extremely strong earthquake which occurred close to the area here described.

Ancient Land Masses Occupied Gulf of St. Lawrence

WASHINGTON, November 16 — A low range of mountains once extended across what is now the mouth of the Gulf of St. Lawrence according to Dr. R. D. Hutchinson of the Geological Survey of Canada.

On either side of this land barrier, he told the Geological Society of America today, there extended a long narrow sea which was in existence about four hundred million years ago.

The evidence for his conclusions resulted from geological work on the Cambrian strata of Cape Breton Island, Nova Scotia. He found that the rocks on the Island become coarser to the westward, indicating that the sediments came from that direction. Somewhat the same situation holds true in Newfoundland to the northeast, indicating that a long narrow land mass extended in a northeast-southwest direction, probably from New Brunswick toward the Strait of Belle Isle.

West of this ancient land mass was another arm of the ocean which extended southwestward along what are now the mountains of western New England.

Further evidence comes from the nature of the fossils on Cape Breton Island which are closely related to those of northwestern Europe but are totally different from the ones found in rocks of the same geologic age in the interior of North America. It is concluded that the long narrow range of low mountains separated the two seas, thus preventing animals in the eastern seaway from migrating westward.

VERMONT SHOWN TO HAVE LARGE RESERVES OF TALC

WASHINGTON, Nov. 12 — A preliminary report on investigations in Vermont concerning talc, one of the most important of non-metallic minerals, has been completed by A. H. Chidester, M. P. Billings, and W. M. Cady of the U. S. Geological Survey.

Talc is a mineral commonly known as "soapstone" in its compact form. Among mineralogists it is called **steatite.** An acid magnesium silicate, it is very soft and can be easily scratched with the fingernail. It feals greasy to the touch and in color it ranges from pearly white or yellow, to gray and frequently green. The United States produces more than 500,000 short tons a year with a total value of around $8,000,000.

Commercial talc deposits are found in Vermont along a narrow belt of rocks extending northward through the central part of the state from the Massachusetts border to Canada.

The authors show how talc deposits occur at the margins of what are called "ultramafic igneous bodies," generally greenish rocks known as "verde antique," ranging in width from a few feet to about a mile, and in length from less than 100 feet to 3½ miles. Mostly pod-shaped, the talc ore bodies are mostly found in country rock of schist, greenstone, or quartzite with a thick layer of grit generally separating the thin talc deposits from the more massive body of unaltered serpentine.

But there is considerable disagreement and discussion among geologists concerning the origin of these "ultramafic" rocks and their derivates. Some believe they were pushed up from below as intrusive molten magma; others, that they were formed by an accumulation of crystals that were intruded in the solid or partly solid state. The process of turning into serpentinite is generally considered to have been brought about by the action of hot water relatively soon after intrusion. Transformation into steatite or talc, commonly attributed to hot water solutions from underlying magmas, is considered to be a later process, independent of serpentinite.

Vermont has very large reserves of talc, the report says, "probably adequate to meet normal as well as emergency demands for many years to come." However a discussion of proved talc reserves is not possible, inasmuch as the mining companies do not attempt to block out ore reserves several years in advance.

But because one of the purposes of the present investigations is to derive a detailed estimate of indicated and infered talc reserves, studies were made of about 40 localities that constitute the best known talc prospects together with other localities (not visited) taken from the literature. All these are treated in detail by the authors and specific opinions are given concerning the probable amounts of mineral material at each site.

With regards to opening new mines it is stated: "Many years ago, when practically all of the talc mines now operating were opened, labor was readily available, operations were on a comparatively small scale, and only a relatively small outlay of capital was necessary to begin mining operations. Consequently, it was possible to open a mine without risking a very large sum of money. Under those conditions, geologic studies of deposits about to be exploited were considered unecessary. At present, however, with the large initial outlays of capital required to begin mining operations, a deposit should be exploited only after thorough geologic study."

WEST VIRGINIA ONCE COVERED BY SALTY SEA

WASHINGTON, November 18 — Parts of West Virginia were once covered by a shallow salty arm of the ocean according to Dr. J. C. Ludlum of the University of West Virginia.

The presence of salty crystal impressions in chemically deposited limey strata suggests very quiet and shallow water free from normal ocean tides, he told the 63rd Annual Meeting of the Geological Society of America today.

Calling attention to the fact that strong winds or storms would have disturbed the limey and sandy muds which have now hardened into rock, he suggested that this area must have been separated by a protective series of off shore bars from the interior sea which then covered much of North America. This allowed sediments to accumulate so quietly that differences in sediments caused by seasonal weather variations can now be traced in the rock strata.

Because of the presence of salt crystals and the nature of the limestone deposits, he concluded that these deposits in eastern West Virginia were formed at the same time as the thick salt deposits of western New York and northeastern Ohio.

EUROPEAN ORE DEPOSITS SIMILAR TO THOSE IN U. S.

WASHINGTON, November 16 — Lead zinc ore deposits of south central Europe are similar to those of northern Illinois and Wisconsin, H. L. Jicha of Columbia University told the Society of Economic Geologists today in Washington, D. C.

He pointed out that careful study of these well known deposits cast further light on our knowledge of the origin of valuable ores used by modern industry.

Although geologic deposition of the Alpine ore deposits is not precisely the same as those of the northern Mississippi Valley, investigation reveals that they have many similarities. Comparison of these deposits is yielding information concerning the basic nature of their origin and their relation to other similar deposits throughout the world.

He pointed out that careful study of the way in which ore deposits are formed and the way in which they are contained in the surrounding rocks gives clues which are valuable in the search for new ore deposits which are badly needed today. In addition, information supplied by these studies helps to predict the location of new and useful ore deposits in regions which have been thought to be exhausted.

BAUXITE DEPOSITS UNDERLY ANCIENT SWAMP

WASHINGTON, November 16 — Plant remains almost 60,000,000 years old give new information concerning the history of the Arkansas bauxite deposits, said Drs. R. M. Dreyer and W. H. Horr of the University of Kansas today. The plant remains show that these deposits only lay beneath an ancient swamp, in which grew plants of a type not previously known.

In a technical paper submitted to the Geological Society of America's 63rd annual meeting, the geologists stated that the plant structures were preserved in minute detail by iron sulphide (marcasite), an unusual occurrence.

The discovery casts new light on the geological history of the Arkansas bauxite deposits, our major domestic source of aluminum.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*WORLD GEOGRAPHY OF PETROLEUM. Wallace E. Pratt & Dorothy Good, Editors. 1950. xviii, 464 p., 98 pls., 60 figs.; $7.50. (Spec. Pub. 31, Am. Geog. Soc.; Princeton University Press, Princeton, N. J.)

A comprehensive discussion of the distribution and the nature of the accumulations of petroleum, this book also deals with the functional organization of the petroleum industry and the utilization of the world's oil. Among the sixteen individual papers describing the world's petroleum regions are three especially interesting sections on occurrences in the potentially productive regions such as the polar areas and the continental shelves. A comprehensive regional bibliography is included. The petroleum geologist should welcome this new approach to the science. The value of this work is enhanced by an excellent selection of photos and maps.

MINERAL COMMODITIES OF CALIFORNIA. Staff of the Calif. Division of Mines under the direction of Olaf P. Jenkins. 1950. 444 p., 18 pls.; $2.00. (Bull. 156, Calif. Div. of Mines, San Francisco).

The subtitle of this volume, "Geologic occurrence, economic development, and utilization of the State's mineral resources", shows the extensive coverage of more than 80 of California's raw mineral materials. The main part of the book consists of individual commodity reports, sectioned under mineral fuels, nonmetallic industrial minerals, and metals. Mineral statistics by mineral substance and by counties are summarized for 1947 and 1948. A directory of mineral producers, dealers, and commercial laboratories is also included. The enclosed map showing the general distribution of the principal mineral resources, on the back of which are a description and map of the State's geomorphic provinces, may be purchased separately ($0.50).

OTHER PUBLICATIONS RECEIVED

GROUNDWATER IN THE PEORIA REGION. Part 1—Geology (Leland Horberg); Part 2—Hydrology (Max Suter); Part 3—Chemistry (T. E. Larson). 1950. 128 p., 4 pls., 53 figs.; free. (Bull. 75, Ill. State G. S., Urbana). A summary of the geologic conditions controlling the occurrence of ground water in the Peoria region and an attempt to evaluate these conditions, indicating favorable areas for the development of additional groundwater supplies

MINERAL RESOURCE RESEARCH AND ACTIVITIES OF THE STATE GEOLOGICAL SURVEY, 1948-1949. M. M. Leighton. 1950. 24 p., 13 figs.; free. (Circ. 166, Ill. State G. S., Urbana).

OIL AND GAS DEVELOPMENTS IN ILLINOIS IN 1949. Alfred H. Bell and Virginia Kline. 1950. 42 p., 3 figs.; free. (Ill. Petroleum, 62, Ill. State G. S., Urbana).

CARROLL COUNTY GEOLOGY. Franklin E. Vestal. 1950. 114 p., 1 pl., 24 figs.; free. (Bull. 67, Miss. State, G. S., University). Based on a rapid reconnaissance survey, it deals mainly with the geologic formations at the surface, treating briefly the climate, physiographic features, structural geology, geologic history, and economic geology.

DANIELS FLATS MAP-AREA, ALBERTA. E. J. W. Irish. 1950. ii, 30 p., 1 pl.; $0.10. (Paper 50-12, G. S. of Canada, Ottawa).

THE GROUNDHOG COALFIELD, BRITISH COLUMBIA. A. F. Buckham and B. A. Latour. 1950. vi, 82 p., 2 pls., 5 figs.; $0.75. (Bull. 16, G. S. of Canada, Ottawa). This report covers the location, means of access, history, and geology and structure of the coal

measures. All known locations of coal occurrences are described.

SALMO MAP-AREA, BRITISH COLUMBIA. H. W. Little, 1950. ii, 44 p., 1 pl.; $0.10. (Paper 50-19, G. S. of Canada, Ottawa).

NORTHEAST PART OF GIAQUE LAKE MAP-AREA, NORTHWEST TERRITORIES. L. P. Tremblay. 1950. ii, 38 p., 1 pl.; $0.10. (Paper 50-18, G. S. of Canada, Ottawa).

NORTH SHORE OF THE ST. LAWRENCE FROM AGUANISH TO WASHICOUTAI BAY, SAGUENAY COUNTY. Jacques Claveau. 1950. iv, 40 p., 25 pls.; free. (Geol. Rpt. 43, Quebec Dept. of Mines, Quebec).

THE MINING INDUSTRY OF THE PROVINCE OF QUEBEC IN 1948. 1950. 88 p.; free. (Quebec Dept. of Mines, Quebec).

MINERALOGY OF THE GOLDFIELDS DISTRICT, SASKATCHEWAN. S. C. Robinson. 1950. 38 p., 1 fig.; $0.10. An interim account of the uranium minerals in the Goldfields and Martin Lake map-area, other minerals with which they are associated, and the types of deposits in which they are found.

Water Resources

OCTOBER 1950

Runoff was deficient in most of the eastern Provinces, southern New England, and New Jersey, and was below normal generally in the Northeast and much of the Great Lakes region, but no shortages of water have been reported. Ground-water levels were also well below normal in many places.

In the West, the contrast between excessive and deficient runoff increased. Floods occurred in western Oregon and northern California and flow at several gaging stations in Arizona reached new lows for October. Ground-water levels continued to decline in Santa Barbara and Los Angeles Counties, Calif.

Runoff over most of the Central and Southern States was excessive, but only in comparison with normally low October stream flow.

— WATER RESOURCES REVIEW

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) Of The Earth Science Digest published monthly at Boston, Mass., for October 1, 1950.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publishers: Jerome M. Eisenberg, 77 Victoria St., Revere, Mass. and S. Albert Eisenberg, 77 Victoria St., Revere, Mass.; Editor Jerome M. Eisenberg 77 Victoria St., Revere, Mass.; Managing editor Jerome M. Eisenberg, 77 Victoria St., Revere, Mass.; Business manager Gertrude Roberts, 77 Victoria St., Revere, Mass.

2. The owner is: The Earth Publishing Co., Box 28, Revere, Mass.; Jerome M. Eisenberg, 77 Victoria St., Revere, Mass.; S. Albert Eisenberg, 77 Victoria St., Revere, Mass.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

JEROME M. EISENBERG
Editor, publisher.

Sworn to and subscribed before me this 23rd day of October, 1950.

MAURICE M. GOULD, Notary
(My commission expires June, 1952)

The BOOK SHELF

All books listed here may be obtained by sending a check or money order to THE BOOK SHELF, THE EARTH SCIENCE DIGEST, REVERE, MASS.

[We pay postage in the United States]

New Books

The following books were not listed in our complete catalog of books on the earth sciences, which appeared in the Earth Science Digest from June 1949 to January 1950.

THIS EARTH OF OURS by C. W. Wolfe. 1950. 384 pp., 239 figs.	$ 5.00
THE CAVE BOOK by Charles E. Hendrix. 1950. 68 pp., 34 figs.	1.00
STRUCTURAL PETROLOGY OF DEFORMED ROCKS by H. W. Fairbarn. 1949. 344 pp., 213 figs.	12.50
REBELLIOUS RIVER by J. P. Kemper. 1949. 279 pp., 7 figs.	6.00
APPLIED SEDIMENTATION edited by Parker D. Trask. 1950. 707 pp., 114 figs.	5.00
GRASSLAND HISTORICAL STUDIES by James C. Malin. Vol. I: Geology and Geography. 1950. 377 pp., 5 figs.	2.50
GEOCHEMISTRY by Kalervo Rankama and Th. G. Sahama. 1950. 912 pp., 50 figs.	15.00
INTRODUCTION TO THEORETICAL IGNEOUS PETROLOGY by Ernest E. Wahlstrom. 1950. 366 pp., 155 figs.	6.00
APPLIED HYDROLOGY by Ray K. Linsley Jr., Max A. Kohler, and Joseph L. H. Paulhus. 1949. 689 pp., 329 figs.	8.50
CRYSTALS AND X-RAYS by Kathleen Lonsdale. 1949. 199 pp., 13 pls., 138 figs.	3.75
GEOLOGY APPLIED TO SELENOLOGY — IV: THE SHRUNKEN MOON by J. E. Spurr. 1949. 207 pp., 36 figs.	4.00
A NEW THEORY OF HUMAN EVOLUTION by Sir Arthur Keith. 1949. 451 pp., 1 fig.	4.75
INTRODUCTION TO COLLEGE GEOLOGY by Chauncey D. Holmes. 1949. 429 pp., 312 figs.	4.00
THE ART OF THE LAPIDARY by Francis J. Sperisen. 1950. 382 pp., 1 pl., 406 figs.	6.50
GEOLOGY FOR ENGINEERS by Joseph M. Trefethen. 1949. 620 pp., 242 figs.	5.75
HYDROLOGY by C. O. Wisler and E. F. Brater. 1949. 419 pp., 132 figs.	6.00
NORTHWEST GEM TRAILS by H. C. Dake. 1950. 80 pp., 14 figs.	2.00

Is there a book relating to the earth sciences which you need and which was not listed in our catalog? If so, why not write to us? We can obtain for you practically any "in-print" book published.

The Book Shelf

The Earth Science Publishing Company Revere, Mass.